

VELOCITY STRUCTURE AND PLASMA PROPERTIES IN HALO CMES

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Velocity Structure and Plasma Properties in Halo CMEs

We have identified a set of 23 Halo CMEs and 21 Partial Halo CMEs from the LASCO Halo CME Archive for which UVCS spectra exist through July 2002. For each event we have collected basic information such as the event speed, whether or not UVCS caught the bright front, lines detected, Doppler shift and associated flare class. We are currently analyzing the subset for which UVCS caught the CME front.

We also obtained excellent observations of some of the spectacular events in November 2003, and we have made theoretical calculations pertaining to CME expansion at the heights observed by UVCS (Lin et al. 2004a). In one event we were able to analyze the properties of the current sheet in detail (Lin et al. 2004b).

We have written two papers on the Dec. 28, 2000 partial halo event. This event was chosen to take advantage of the SEP event measured by WIND and ACE, One paper deals with a new density and velocity diagnostic for very fast CMEs, pumping of O VI $\lambda 1032$ by Ly β and pumping of O VI $\lambda 1038$ by O VI $\lambda 1032$ (Raymond and Ciaravella 2004). The other discusses physics of the shock wave and association with the SEP event (Ciaravella et al. 2004).

In the coming year we plan to expand the list of Halo and Partial Halo events observed by UVCS through 2004. We will look at the statistics of the fronts and model the CME expansion away from the radial direction. We will also choose several events for more detailed study, probably including the November 2003 events. We are currently working on a paper on the helical structure of the the August 12, 2000 event and a paper on the impulsive phase O VI emission of several events.

We expect to support extended visits to CfA by S. Mancuso and A. Ciaravella.

In the past year the grant covered some salary support for members of the SAO UVCS team and a 2 month visit to CfA by Angela Ciaravella and a 1 month visit by S. Mancuso, along with trips to meetings by J. Lin and J. Raymond and page charges for three papers. Results have been presented at the CME workshop in Switzer-

land (March 2004), the SHINE meeting (June 2004), the AGU Meeting (May 2004) and IAU Symposium 226 (September 2004).

Bibliography

Densities and Velocities in Fast Coronal Mass Ejections: Radiative Pumping of the O VI Doublet, J.C. Raymond & A. Ciaravella 2004, ApJ Letters, 606, L159

Detection and Diagnostics of a Coronal Shock Wave Driven by a Partial-Halo CME on 2000 June 28, A. Ciaravella, J.C. Raymond, S.W. Kahler, A. Vourlidas & J. Li 2004, ApJ, in press

Direct Observations of Magnetic Reconnection Sites of an Eruption on November 18, 2003, J. Lin, Y.-K. Ko, L. Sui, J.C. Raymond, G.A. Stenborg, Y. Jiang, S. Zhao & S. Mancuso, 2004b, submitted to ApJ

Observational Consequences of the Catastrophe Model for Solar Eruptions, J. Lin, J.C. Raymond & A. A. van Ballegoijen 2004a, ApJ, 602, 422